



Research Article

Effect of Heavy Metal Pollution on Survival and Protein Changes in Liver and Intestine of Fresh Water Fish *Tilapia mossambica*

Lalit Choudhary¹ and Seema Bhardwaj^{2*}

¹Department of Zoology, Aravali Mahavidyalaya, Banswara-327001, Rajasthan, India.

²Department of Zoology, HDJ Govt. Girls P.G College, Banswara-327001, Rajasthan, India.

Abstract: The heavy metal salts constitute a very serious type of pollution because they are stable compounds and are not readily removed by oxidation, participations or other means and affect the activity of animals. The toxicity of Hg, Cd, Zn and their compound to fish has received the attention of a number of workers in recent years. In the present study, it is observed that contents of protein decreased gradually with an increase in concentrations of metals and damage of respiratory surface.

Keywords: Pollution, Heavy Metal, *Tilapia mossambica*, Toxicity.

1. Introduction

During the last decades, a considerable amount of work has been done on the effect of heavy metal pollution on freshwater fishes. The reason is that the heavy metal salts constitute a very serious type of pollution because they are stable compounds and are not readily removed by oxidation, participations or other means and affect the activity of animals. Eisher (1973) extensively elaborated the biological effect of metals on aquatic organisms and contented that metals along with other substances are the most toxic pollutants of river systems. The toxicity of mercury and other heavy metals in fish has received the attention of a number of workers in past years, Dokholyan *et al.*, (1978); Ahamed (1979); Ram (1984); Meenakshi (1998); Hameed *et al.*, (2006); Al-Bairuty *et al.*, (2013); Ciji and Bijoy (2014). Its presence in natural waters has recognized as an environmental hazard in many countries. Brain, liver and kidney are the most sensitive organs for mercurial compounds. Several workers have attempted to explain the effects of mercury and other heavy metals. The toxic effects of mercury on the digestive system of fish have been studied by Sastry *et al.*, (1978 & 1979). Enzymological and Biochemical changes produced by mercuric chloride in a teleost fish were studied by Sastry *et al.*, (1981). Adam *et al.*, (1990), studied the effect of lead nitrate and lead acetate on the growth and some metabolic processes of

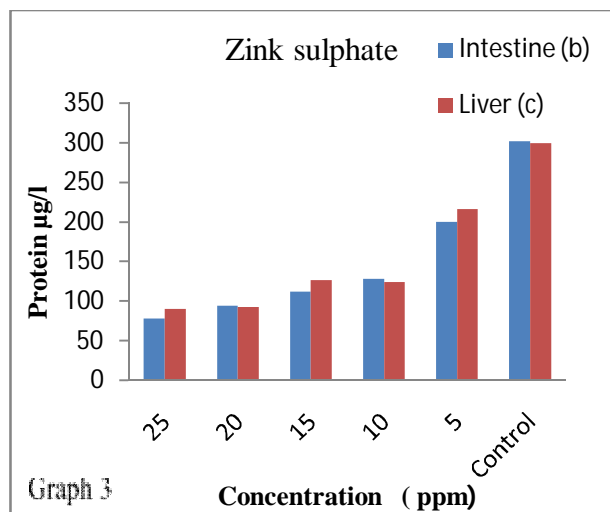
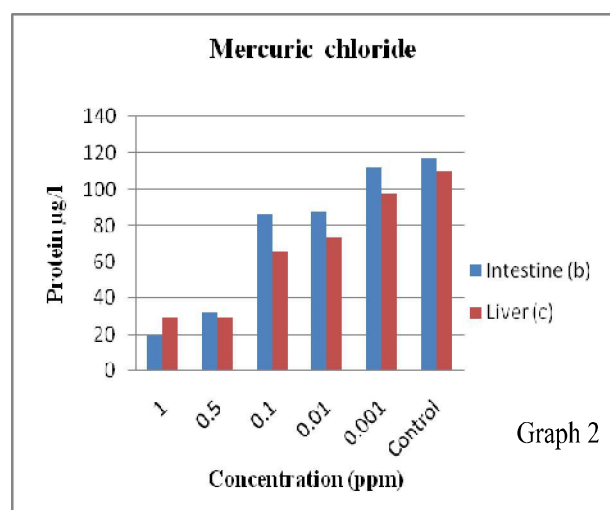
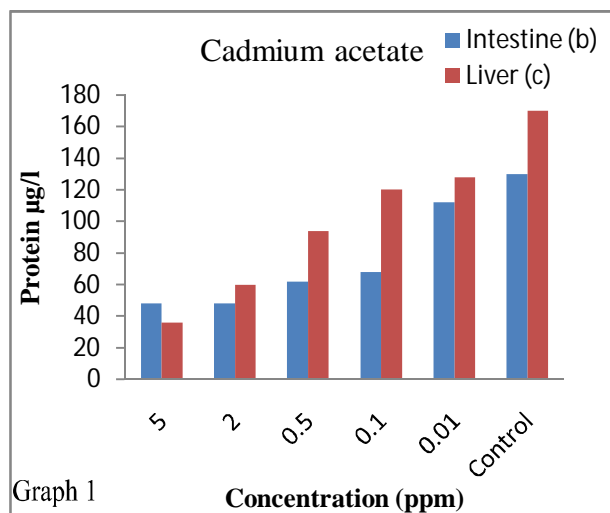
Scenedesmus obliquus. Paul *et al.*, (2014) studied the effects of lead toxicity in intestinal macrophages of *Channa punctatus*. In present investigative efforts have been made to acquire information on the effects of zinc sulphate and cadmium acetate and mercuric chloride on survival of the fishes and to examine whether these metals can affect the metabolism and cause changes in carbohydrates and proteins in the liver and intestine in a freshwater fish '*Tilapia mossambica*'.

2. Material & Methods

Tilapia mossambica fishes of both sexes having approximately equal size (4-5cms) and age were collected from a local pond and brought to the laboratory. They were held in glass aquaria containing continuously aerated well water which was used in all tests. Each aquarium contained ten fishes which were kept under normal light / dark illumination. The fishes were fed 1% per body weight with dried shrimp powder once per day. In order to ascertain the lethal concentration of the pollutants, groups of 10 fishes were kept in each aquarium containing 30 liters of well water having different concentrations of zinc sulphate (25, 20, 15, 10, 5mg/l), cadmium acetate (5, 2, 0.5, 0.1, 0.01mg/l) and mercuric chloride (1, 0.5, 0.1, 0.001mg/l). Along with each experimental group, a corresponding control unit was also set up for the experimental period in well water to compare the

*Corresponding author:
E-mail: seema377@gmail.com.

results. Protein was estimated in intestines and liver, according to Lowry *et al.*, (1951) and Oser (1976) LC_{50} values were calculated by graphical interpolation as per Litchfield *et al.*, (1949).



- a. All concentration expressed in mg/l;
b. All value expressed in µg/0.2ml.

3. Result & Discussions

The present study shows that the survival of the fish decreased with increase in the concentration of metal. Data obtained in this study reveals that the fishes survival in 5mg/l concentration in zinc sulphate, 0.1mg/l concentration of Cadmium acetate and 0.001mg/l concentration of mercuric chloride. If the LC_{50} value of the fishes in three pollutants are compared (Mercuric chloride, Cadmium acetate and Zinc sulphate), it is higher in mercuric chloride than that of cadmium acetate and zinc sulphate. The LC_{50} value for *Tilapia mossambica* with zinc sulphate was 7.5mg/l, Cadmium acetate 0.3mg/l Mercuric chloride 0.005mg/l hence it appears from the study that mercuric chloride was more toxic than cadmium acetate and zinc sulphate. The cause of death owing to lethal action of metals may be, due to damage of the respiratory surface over the gill and damage of body surface similar reasons have been given by Nagbhushnam *et al.*, (1981) in prawn and Rajesh Kumar and Munuswamy (2011) reported heavy metal (Cu, Pb, Zn, Cd, Mn and Fe) accumulation in fish tissues and histopathological damage in hepatocytes, gills and muscle bundles. Allen (1995) observed soft-tissue accumulation of lead in the blue tilapia. A higher concentration, such as 25mg/l zinc sulphate, 5.0mg/l cadmium acetate and 1.0mg/l mercuric chloride, the fishes had almost stopped feeding after 30 days exposure. The results illustrated in Graph 1, 2, and 3 indicate that contents of protein decreased gradually with an increase in concentrations of metals. The decline in the level of proteins after exposure to polluted water of zinc sulphate, cadmium acetate and mercuric chloride may be due to intensive proteolysis in the respective tissue (intestine and liver). Depletion in tissue proteins in fish exposed to various toxicants has also been reported by Hameed *et al.*, (2006); Ahmad (1979); McLeay *et al.*, (1974); Rahman *et al.*, (1984). From the above observations, it can be suggested that heavy metals in the aquatic ecosystem will change the metabolism of the body.

References

- [1]. Adam, M.S. and Basset, R.A. (1990). Effect of lead nitrate and lead acetate on the growth and some metabolic processes of *Scenedesmus obliquus*. *Acta Hydrobiology*, 32 (1): 93-100.
- [2]. Al-Bairuty Genan, A., Shaw, Benjamin, J., Handy, Richard, D. (2013). Histopathological effects of waterborne copper nanoparticles and copper sulphate on the organs of rainbow trout (*Oncorhynchus mykiss*). *Aquatic Toxicology*, 126: 104-115.
- [3]. Allen, P. (1995). Soft-tissue accumulation of lead in the blue tilapia, *Oreochromis aureus* (Steindachner), and the modifying effects of cadmium and mercury. *Biol. Trace Elem. Res.*, 50(3):193-208.

- [4]. Ciji, P.P. and Bijoy Nandan (2014). Toxicity of Copper and Zinc to *Puntius parrah* (Day, 1865). *Marine Environmental Research*, 93:38-46.
- [5]. Diwan, A.D., Hingorani, H.G. and Chandrashekhram Naidu, N. (1979). Levels of blood glucose and tissue glycogen in two live fish exposed to industrial effluent. *Bull. Environ. Contam. Toxicol.*, 21: 269-272.
- [6]. Dokholyan, V.K. & Akhmedova, T.P. (1978). Effect of mercury dichloride on some biochemical indexes of the brain, blood and liver of *Rutilus rutilus Capicus*. *Vopr. Ikhtiol.*, 18:177-180.
- [7]. Eisher, R. (1973). Annotated bibliography on biological effects of metals in aquatic environment. EPA, Ecol. Res. Ser. EPA 3-73-007, Washington D.C.
- [8]. Hameed, S.V.S.A. and Muthukumaravel, K. (2006). Impact of cadmium on the biochemical constituents of freshwater fish *Oreochromis mossambicus*. *Indian J. Environ. Sci.*, 10 (1): 63-65.
- [9]. Hodson, P.V. (1976). Temperature Effects on Lactate-Glycogen Metabolism in Zinc-Intoxicated Rainbow Trout (*Salmo gairdneri*). *Journal of the Fisheries Research Board of Canada*, 33: 1393-1397.
- [10]. Litchfield, J.T. Jr. and Wilcoxon, F. (1949). A simplified method of evaluating doses-effect experiments. *J. of Pharmacol. Exp. Ther.*, 96:99-113.
- [11]. Lowry, O.H., Rosebrough, N.J., Farr, A.L. and Randall, R.J. (1951). Protein measurement with the Folin phenol reagent. *J. Biol. Chem.*, 193:265-275.
- [12]. Meenakshi, V. and Pugazhendhy, K. (1998). Toxicity of mercuric chloride to the fingerlings of freshwater fish *Cyprinus carpio* (Linn.). *Uttar Pradesh Journal of Zoology*, 18(3):145-148.
- [13]. Nagbhushnam, R. and Kulkarni, G.K. (1981). Freshwater palaemonid prawn "Macro bacterium Kistnensis" effect of heavy metal pollutants. *Proc. India. Nat. Acad. Sci. B.*, 47, No. 3P 389-396.
- [14]. Oser, B.L. (1976). Hawk's Physiological Chemistry 14th Ed. Tata McGraw-Hill Publ., New Delhi.
- [15]. Palanivelu, P., Vijayavel, K., Ezhilarasi Balasubramanian, S., Balasubramanian, M.P. (2004). Combined effect of cartap hydrochloride and urea on biochemical constituents of freshwater fish *Oreochromis mossambicus*. *J. Ecotoxicology and Environmental Monitoring*, 14 (1):23-29.
- [16]. Paul, N., Chakraborty, S. and Sengupta, M. (2014). Lead toxicity on non-specific immune mechanisms of freshwater fish *Channa punctatus*. *Aquatic Toxicology*, 152: 105-112.
- [17]. Qayyum, M.A. and Shaffi, S.A. (1977). Changes in tissue glycogen on a freshwater catfish *Heteropneustes fossilis* due to mercury intoxication. *Curr. Sci.*, 46, 652-653.
- [18]. Rajesh Kumar, S. and Munuswamy, N. (2011). Impact of metals on histopathology and expression of HSP70 in different tissues of Milkfish (*Chanos chanos*) of Kaattuppalli Island, South East Coast, India. *Chemosphere*, 83: 415-421.
- [19]. Sastry, K.V., Gupta, P.K., Malik, P.V. (1979). A comparative study of the effect of acute and chronic mercuric chloride treatment on the activities of a few digestive enzymes of a teleost fish *Channa punctatus*. *Bulletin of Environmental Contamination and Toxicology*, 22: 28-34.
- [20]. Sastry, K.V. and Rao, D.R. (1981). Enzymological and Biochemical changes produced by mercuric chloride in teleost fish, *Channa punctatus*. *Toxicol. Lett.*, 9: 321-326.
- [21]. Sastry, K.V. and Gupta, P.K. (1978). Effect of mercuric chloride on the digestive system of a teleost fish, *Channa punctatus*. *Bull. Environ. Contam. Toxicol.*, 20(3):353-60.
- [22]. Veena, K.B., Radhakrishnan, C.K. and Chacko, J. (1997). Heavy metal induced biochemical effects in an estuarine teleost. *Indian Journal of Marine Sciences*, 26: 74-78.